F22 Raptor
Lean Manufacturing

F-22 Lean

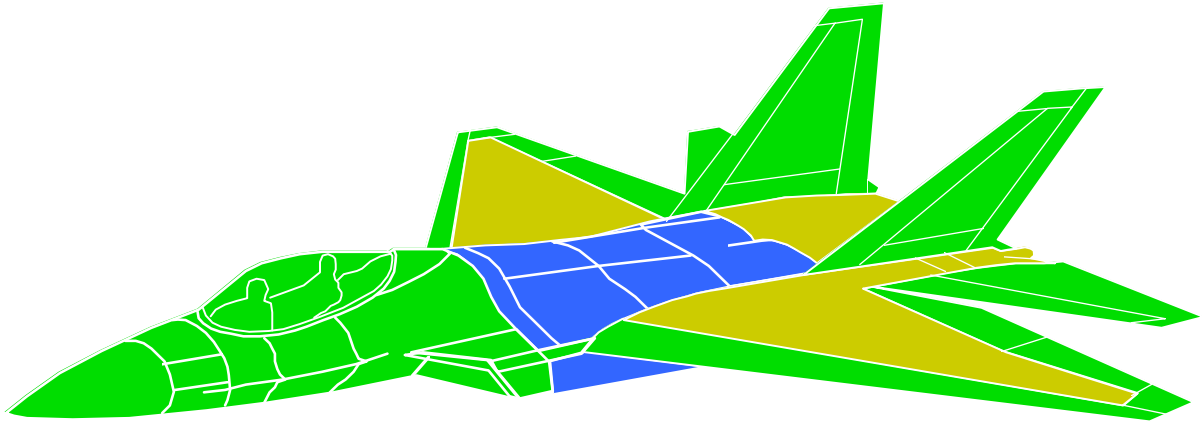
- Concept
  - Why Lean?
  - What does it mean?
- Progress To Date
  - Boeing
  - LM Ft Worth
  - LM Marietta
- Challenges

F-22 Lean: The Concept

- Why?
  - To save the program money
  - To save the industrial base
  - (To save the program)
- What is it?
  - Mindset, cultural change
  - Common sense, real means to improve
  - AIWs, Kaizens, Kaikakus, TOC, 6 Sigma, etc
    - *And everything Snod said*

-22 Can Be More Affordable Through Lea

F-22 Team Responsibilities



Boein	Lockheed Fort Worth	Lockheed Aeronautical
Aft Fuselage	Mid Fuselage	Forward Fuselage
Engine Integration	Electronic Warfare	Edges
Wings	Communication/Nav/	Horizontal Stabilators
Radar	Identification	Vertical Stabilizers
Mission Software	Vehicle Management System	Mate & Final Assembly
Training System	Support System	Weapon System Integration
		Common Integrated Processor

Boeing Lean
Engine Bay Doors AIW

Lean Implementation → Lean Results

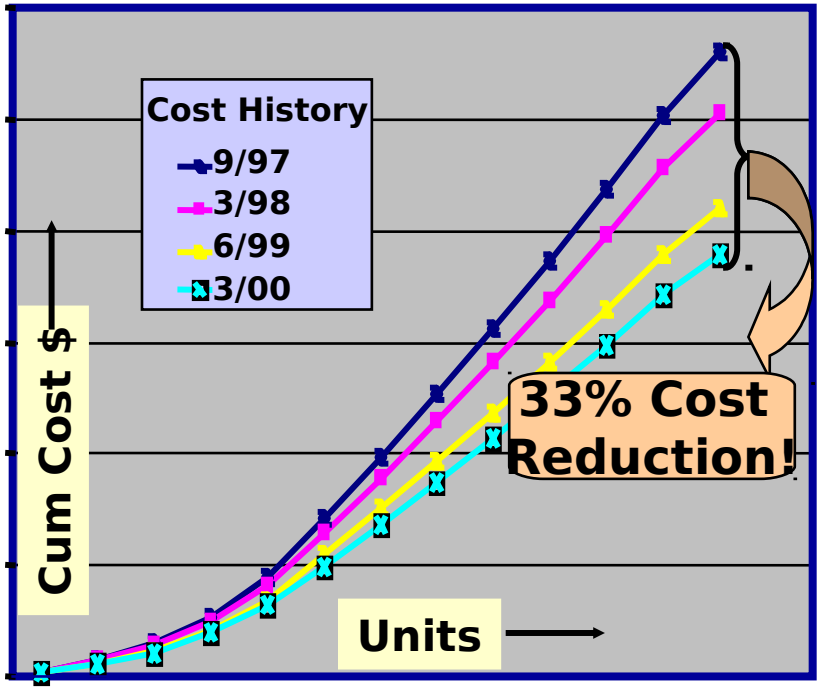
F-22 Lean Event - Boeing/BF Goodrich

Goal: Develop optimum operation for the F-22 Engine Bay Door and Lay-up and Bond Preparation Cell

Results:
- 34% reduction in cycle time (56 vs. 37 days)
- 43% reduction in manufacturing cost
- 28% reduction in floor space
- 25% reduction in staffing
- Point of use tooling implemented
- Future events planned

Before Event

After



Fort Worth Lean

Blitz events in 2000

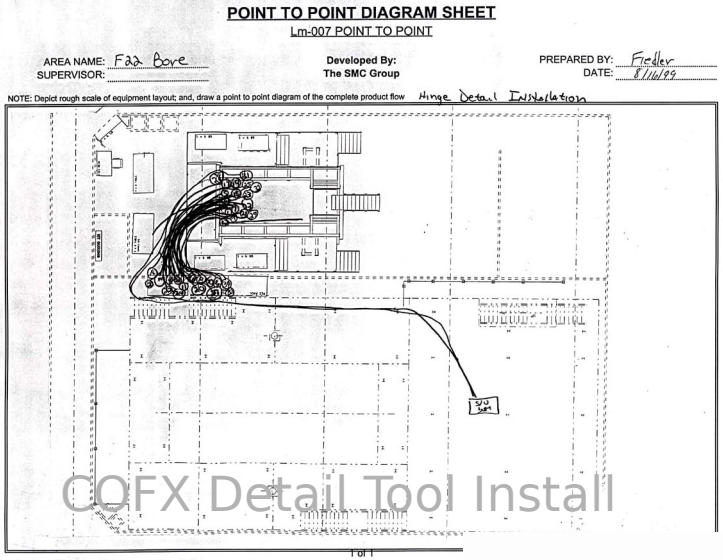
- **Mate Longeron Installation (Build Team)**
  - Operator travel reduced 84%
  - Span time reduced 50% (from 6 to 3 M-days)
  - Touch labor reduced 47%
- **Tool Trial Run (Airframe / Production Control)**
  - Span time reduced 95%
  - Tools tracked and scheduled in MRP
  - Eliminates post inspection tasks
- **Module 4 Upper Surface (Build Team)**
  - Optimize workstation design and layout
  - Conducted 19-26 June

Mid Fuselage Bore Fixture

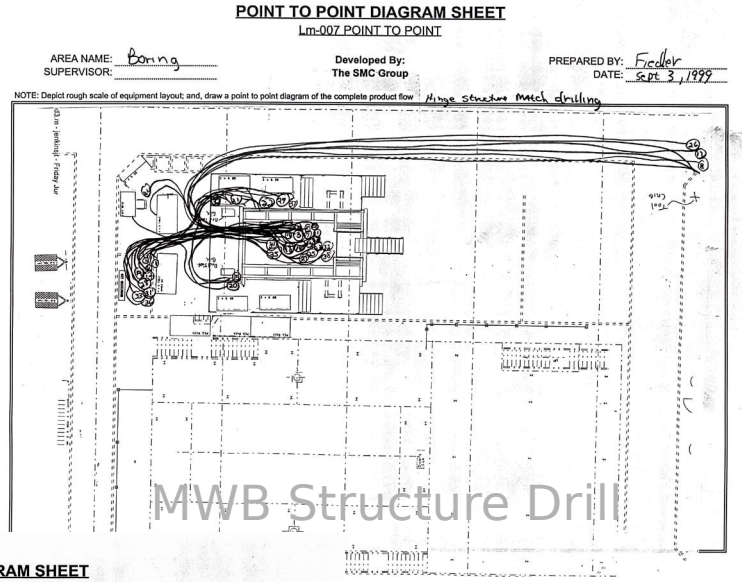
Current Process - Bore Fixture

- Process Baseline was 14 M-days
  - Boring/Spotfacing - 3 days
  - Hinge Installation - 11 days
- Boring must be complete prior to working hinges on structure
- Two fixtures required to meet planned rate
- Boring/Main Weapons Bays Hinges on critical path for Mid Fuselage

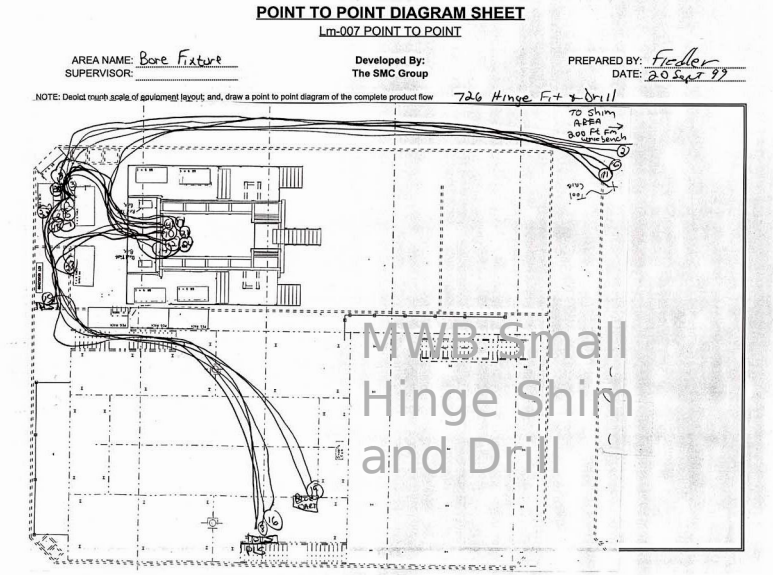
Area Layout/Workstation


POINT TO POINT DIAGRAM SHEET
Lm-007 POINT TO POINT
AREA NAME: F22 Bore
SUPERVISOR:
Developed By:
The SMC Group
PREPARED BY: Fiedler
DATE: 8/16/99
NOTE: Depict rough scale of equipment layout; and, draw a point to point diagram of the complete product flow Hinge Detail Installation
1 of 1

COFX Detail Tool Install

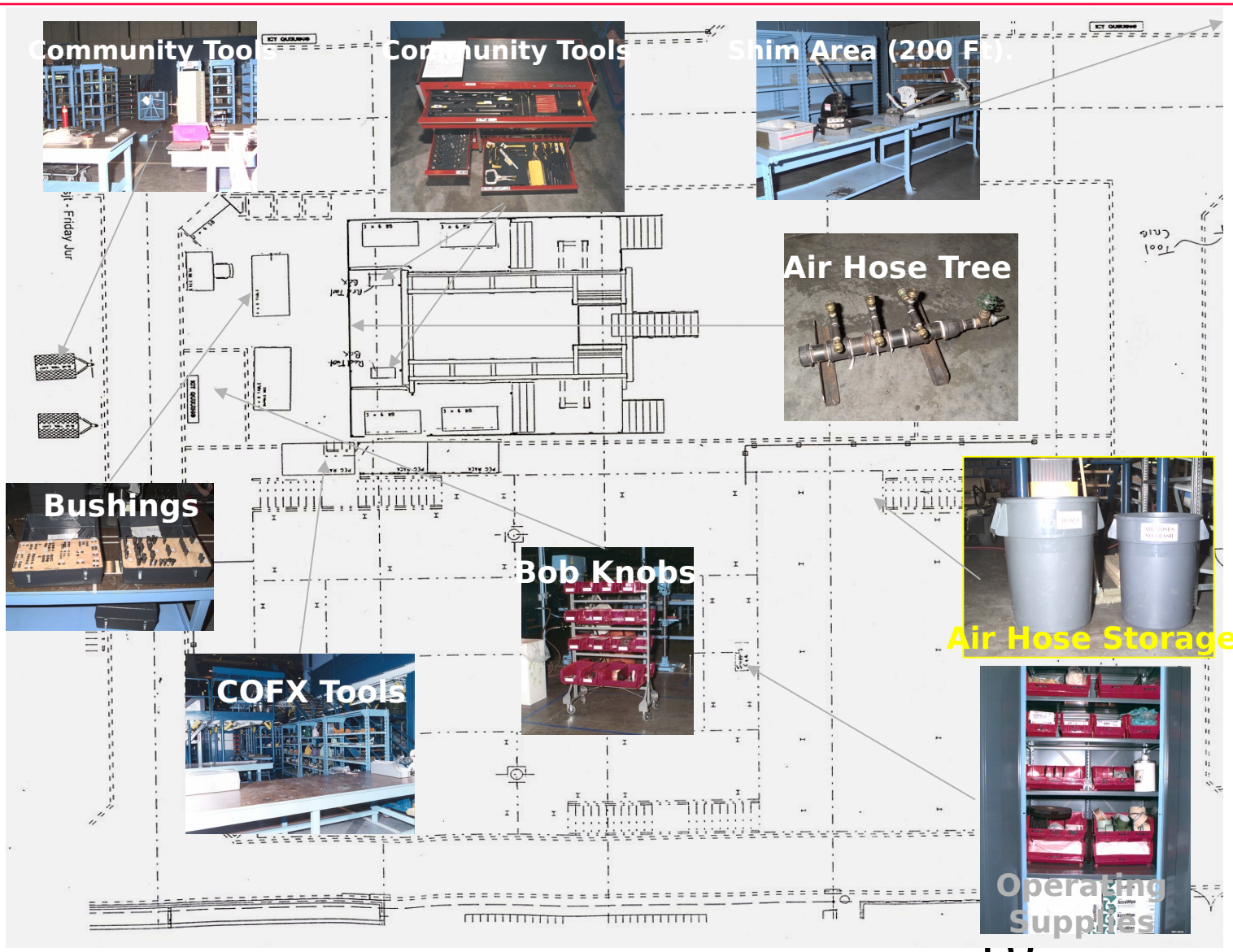

POINT TO POINT DIAGRAM SHEET
Lm-007 POINT TO POINT
AREA NAME: Boeing
SUPERVISOR:
Developed By:
The SMC Group
PREPARED BY: Fiedler
DATE: Sept 3, 1999
NOTE: Depict rough scale of equipment layout; and, draw a point to point diagram of the complete product flow Hinge structure match drilling

MWB Structure Drill

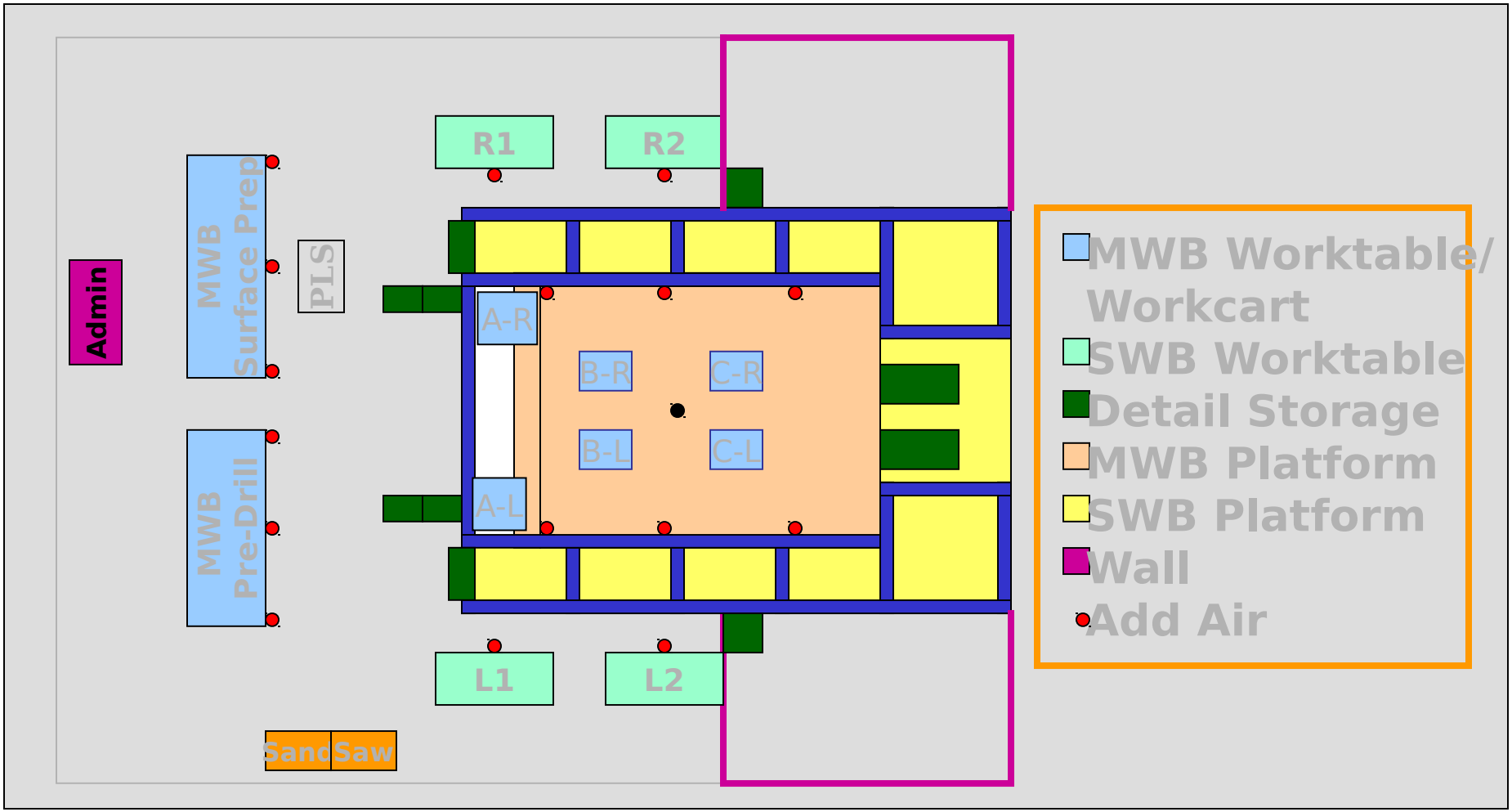

POINT TO POINT DIAGRAM SHEET
Lm-007 POINT TO POINT
AREA NAME: Bore Fixture
SUPERVISOR:
Developed By:
The SMC Group
PREPARED BY: Fiedler
DATE: 20 Sept 99
NOTE: Depict rough scale of equipment layout; and, draw a point to point diagram of the complete product flow 726 Hinge Fit + Drill

MWB Small Hinge Shim and Drill

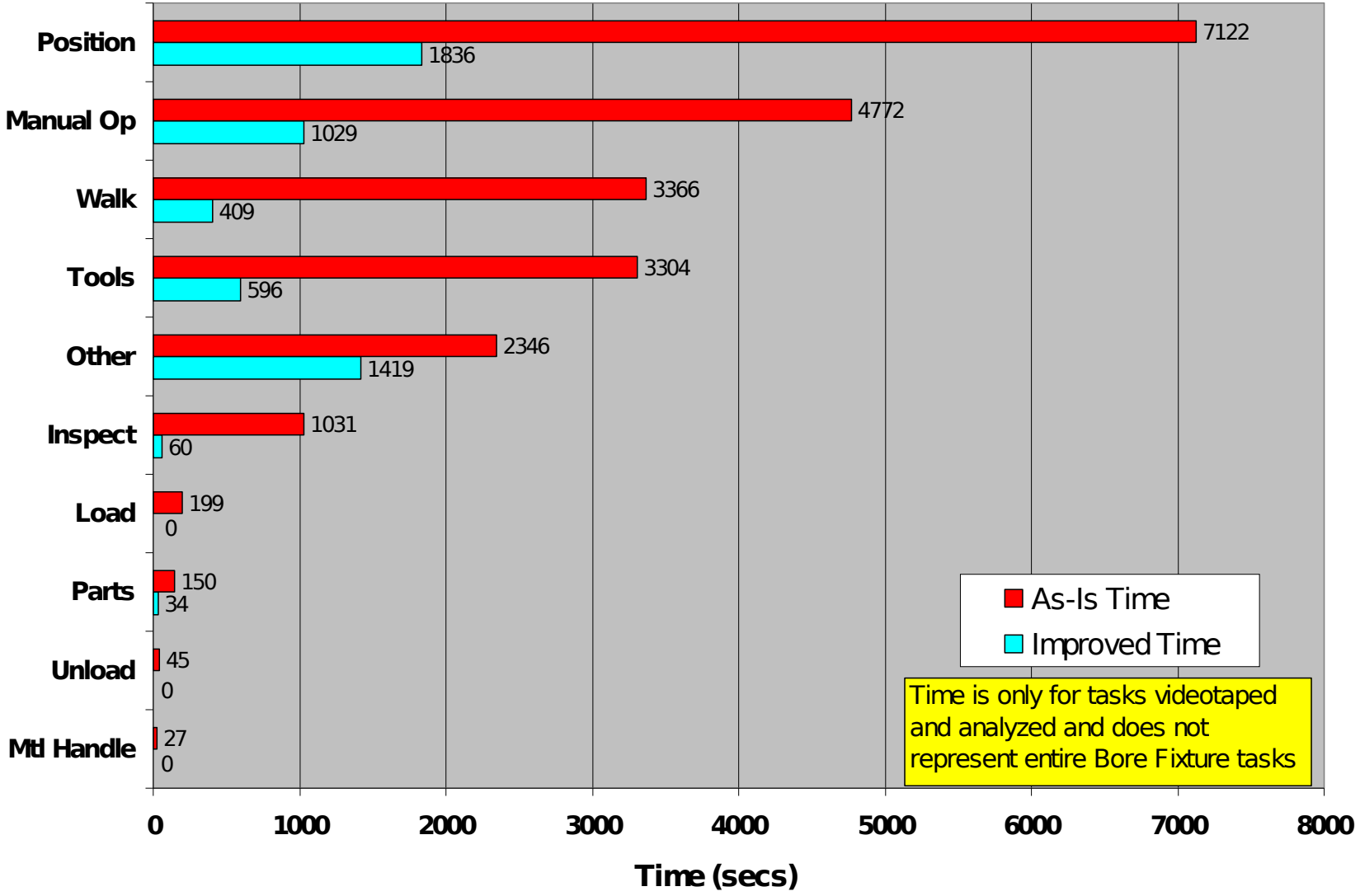
Current Layout



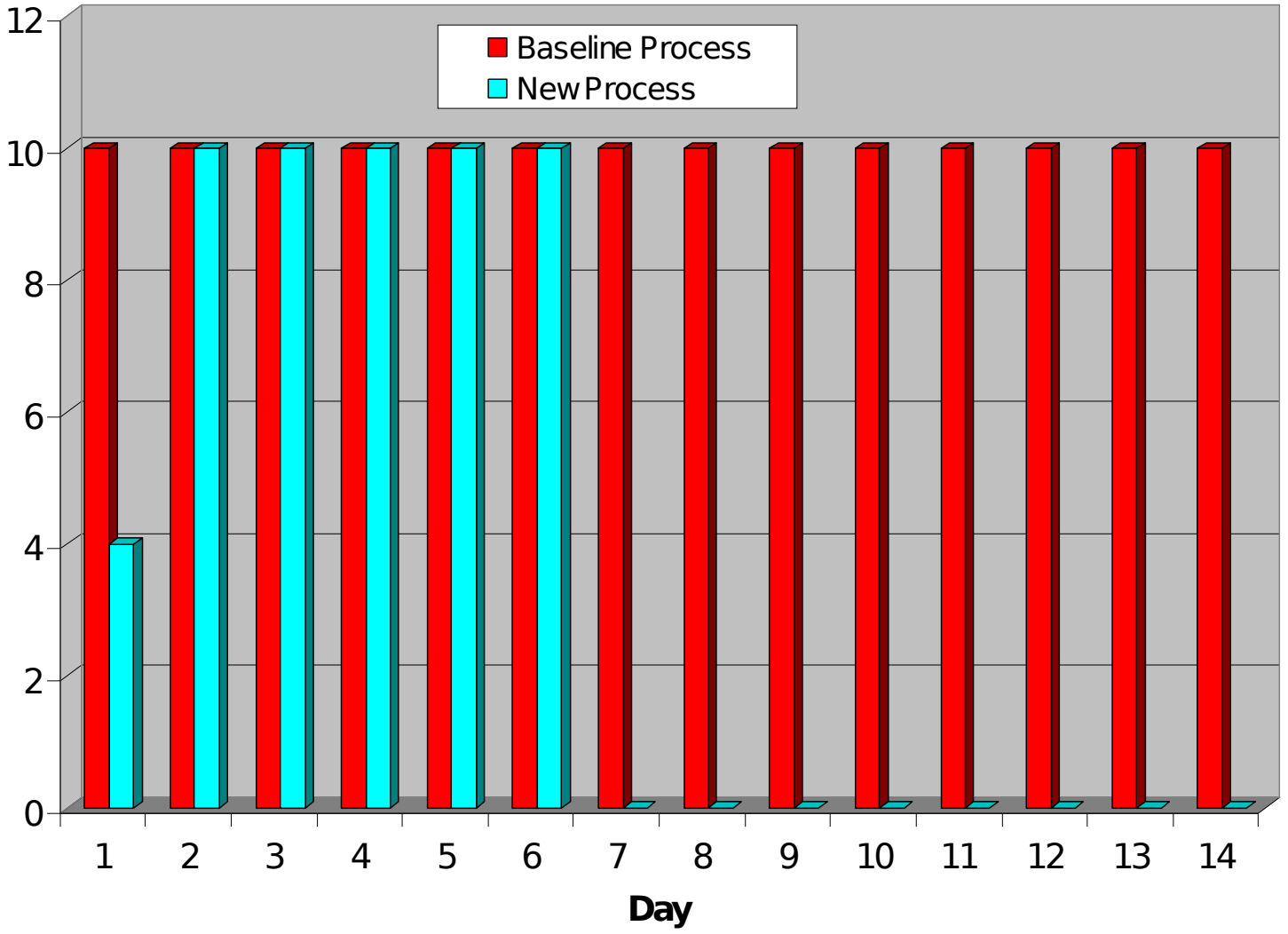
New Area Layout/Workstation



Bore Fixture Process Improvements



Bore Fixture Reduction in Cycle Time



Leaning F-22 Final Assembly

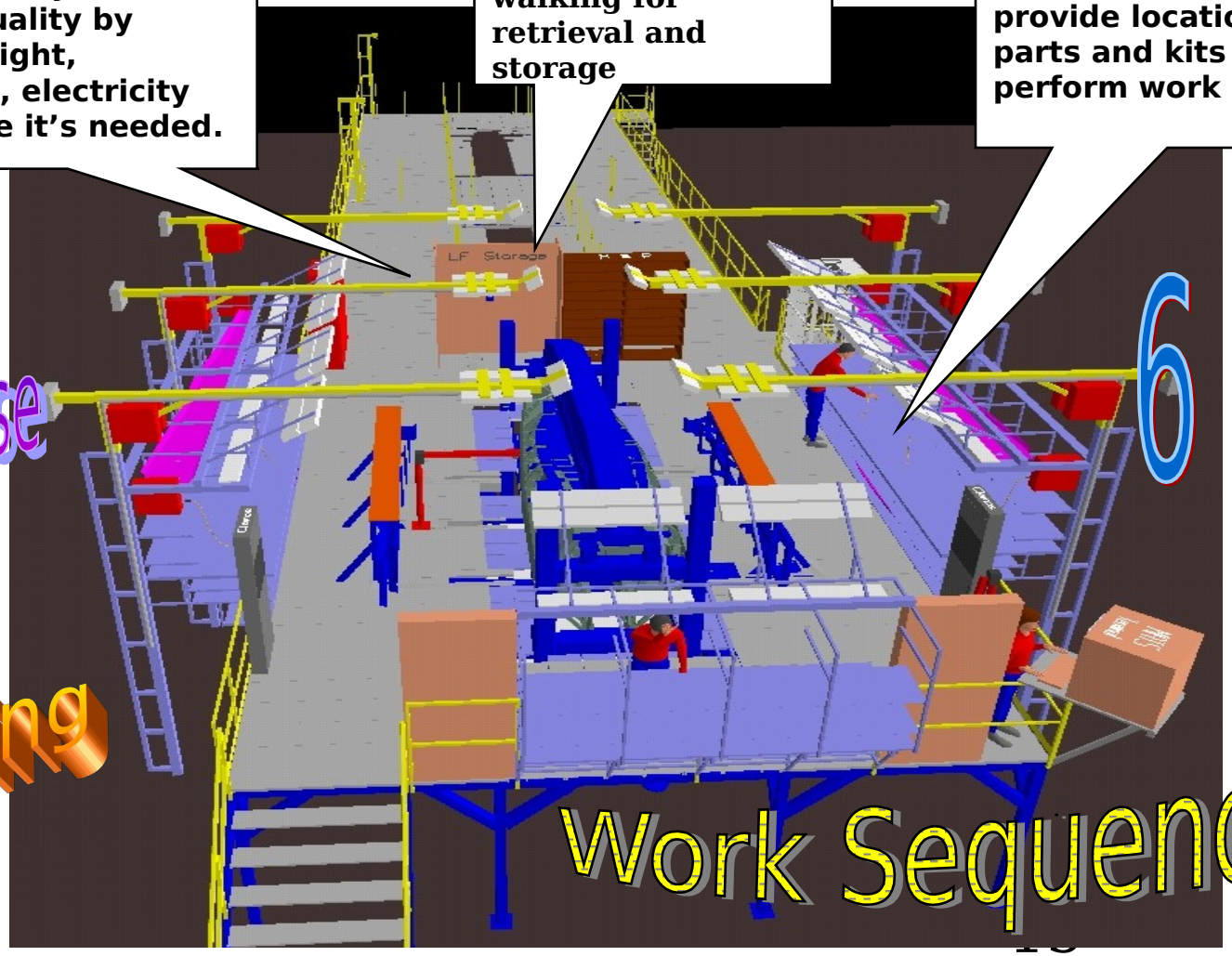
Lean/Six Sigma/ACE/BLITZ/AIW

Fwd Fuselage Build Improvements

Overhead utilities improve safety and improve quality by providing light, air,vacuum, electricity right where it's needed.

Storage racks for POU alignment tools eliminates walking for retrieval and storage

Work / storage tables provide locations for all parts and kits needed to perform work in area.



Point of Use

6 S's

Kitting

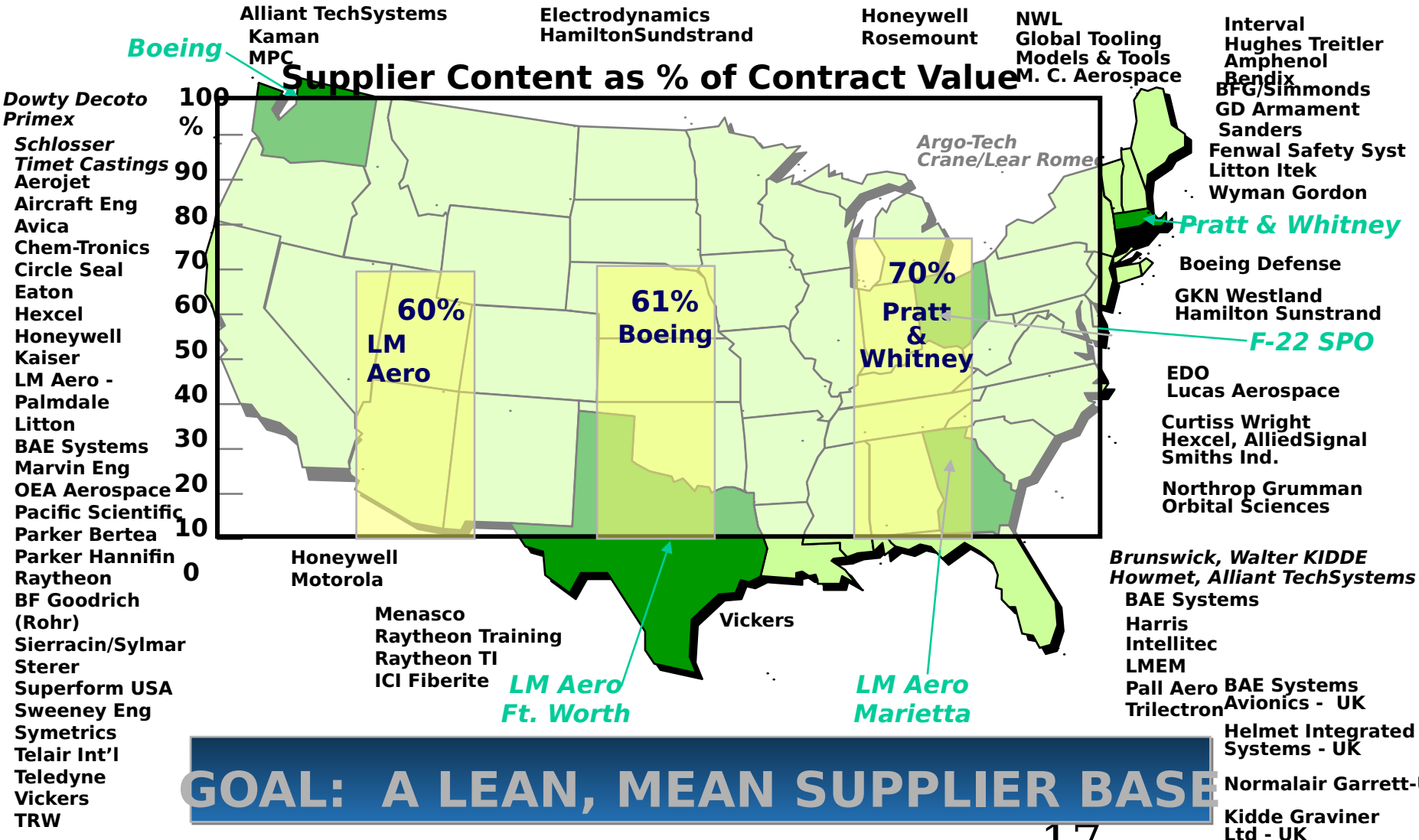
Work Sequencing

Challenges

- Visionary Leadership
- Middle-management (IPT) buy-in
- Cultural Change
- Supplier Partnerships (e.g. LM-Boeing)
- ***Leaning out Suppliers***

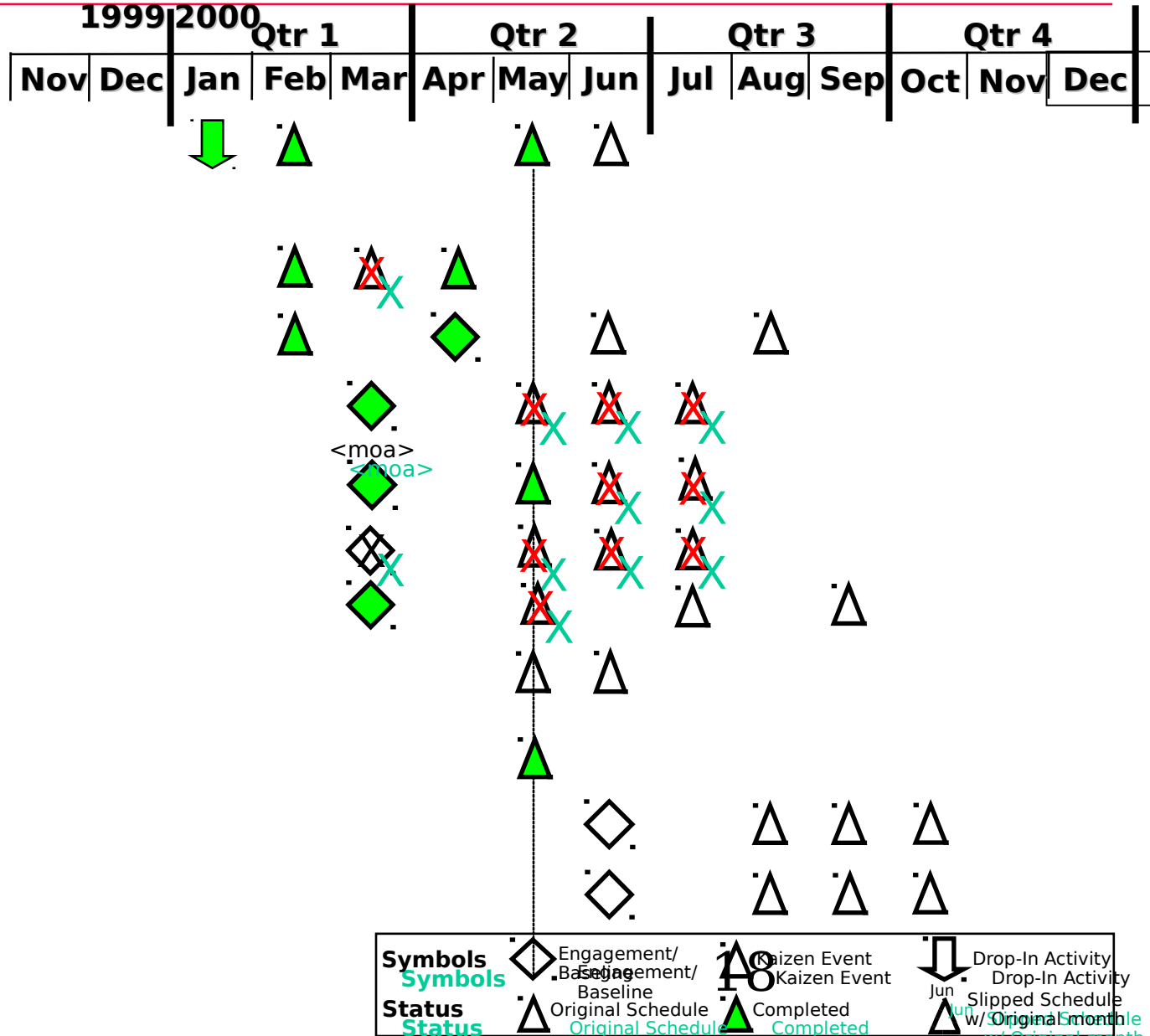
Supply Chain Must be Lean from Top to Bottom

One Challenge Ahead

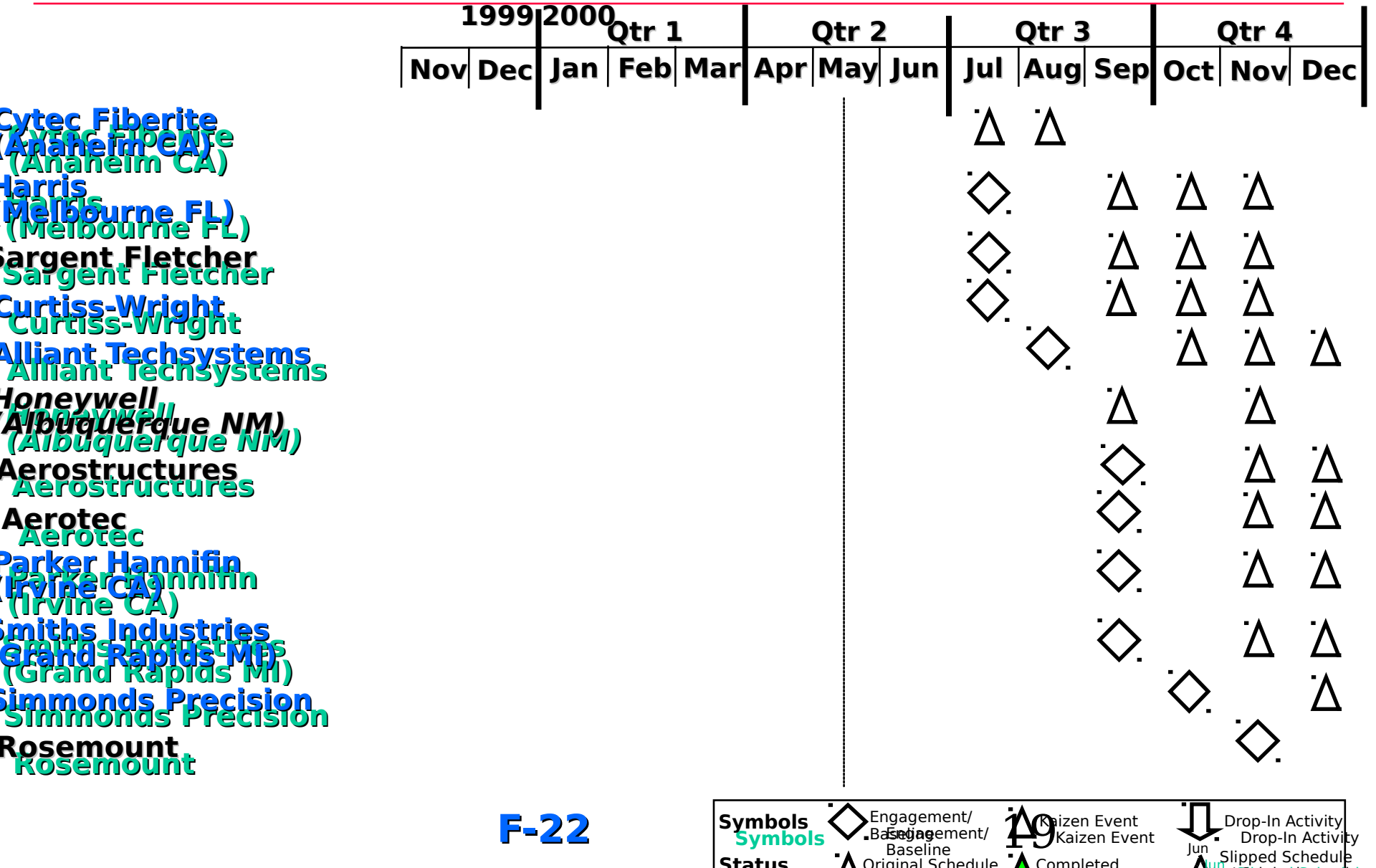


GOAL: A LEAN, MEAN SUPPLIER BASE

Lean Deployment 2000 Master Schedule



Lean Deployment 2000 Master Schedule



Summary/Lessons Learned

- Lean Implementation Continues to be Successful
  - $200+ M in Documented Savings to Date
  - Will yield $2-4B in Program Production Savings –

    or else!
- Most Successful Applications/Events are IPT Created
  - Pushing Lean on IPT's Hasn't worked
  - Need IPT's to PULL Exec Lean Team Involvement
- *"Need Leadership to Help Create Environment that Will Cause IPT's to Have Ownership in Implementing Lean"*
- Suppliers must be Leaned Out

Leadership Challenge:
Lead Horse to Water…. Make Him Thirsty